

Discovery Dispatch

A Quarterly Newsletter of the NASA Discovery Program

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A Note From the Program Manager

I'd like to thank everyone for their participation in the 3rd annual Discovery Program Retreat, which led to a successful set of briefings and discussions over the course of the two-day session. I was very pleased with the turnout and the discussions and interactions amongst all of the people involved with the Discovery Program.

For those who were unable to attend, the Discovery Retreat took place April 23-24 in Easton, Maryland, on the Chesapeake Bay. Representatives from all of the Discovery missions participated, along with a number of folks from NASA Headquarters - including Solar System Exploration Division Director Colleen Hartman. There were excellent presentations from Genesis (the last mission to launch) and CONTOUR (the next one on the pad), and from the recently-selected NetLander, Dawn and Kepler missions. Also valuable discussions took place on many topics including lessons learned for launch preparations, launch vehicles, education and public outreach, and project accounting and reporting practices.

With the arrival of the CONTOUR spacecraft at the Kennedy Space Center on April 24 to begin final preparations for launch, it's a good time to reflect and recognize the tremendous effort it takes to get to this point. Many people with very diverse skills and expertise came together to develop, build, and integrate the spacecraft components and science instruments and to get it to the launch site. Congratulations to Principal Investigator Joseph Veverka, Project Manager Mary Chiu and everyone who has contributed to the CONTOUR mission for getting the integrated spacecraft to the Cape. We all look forward to some early Fourth of July fireworks in Florida, courtesy of our friends at KSC and Boeing.

GO CONTOUR!!!

Dave Jarrett

CONTOUR—The Closest Look Yet at Comets

Questions about comets have puzzled scientists for hundreds of years: What happens to a comet's surface as it approaches the Sun? What is its chemical composition? How does a comet's nucleus spin—does it wobble or spin one way? How are comets alike or different? Distant observations of comets haven't provided answers, but soon the Comet Nucleus Tour, or CONTOUR, mission may. When CONTOUR launches from Cape Canaveral in July 2002, it will be on a mission to get closer than ever before to at least two comets.

CONTOUR will fly deep within the coma, or tail, of comets Encke and Schwassmann-Wachmann 3, as close as 60 miles (100 km) from the comet's nucleus. It will build on the results of the 1986 Halley and the 2001 Borrelly comet flybys, and contribute in unique ways to the body of cometary knowledge to be gained within the next four years from two other NASA Discovery missions to comets, Stardust and Deep Impact.



Artist's concept of the CONTOUR satellite

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Discovery Home Page

<http://discovery.nasa.gov>

CONTOUR will carry four science instruments to accomplish its goals:

- CRISP, the CONTOUR Remote Imager/Spectrograph, will map the locations of different rock and ice types on the nucleus and take high resolution images.
- NGIMS, the Neutral Gas Ion Mass Spectrometer, will determine the abundance and isotope ratios of atoms, molecules, and ions in the coma of each comet.
- CIDA, the Comet Impact Dust Analyzer, will determine the composition of the dust surrounding the nucleus, providing a direct comparison of the comets CONTOUR visits.
- CFI, the CONTOUR Forward Imager, will locate the target comet against the star background before an encounter. It will take color images of the nucleus, any gas or dust jets, and other features in the inner coma, along with imaging the inner coma in wavelengths sensitive to ionized gas.

The Origin of CONTOUR

Principal Investigator Joe Veverka says, "For CONTOUR there were two people involved in getting things started. My interest has always been in figuring out what comets can tell us about the early history of the solar system, both in terms of the ices and gases and some of the organic molecules that they clearly contain. I wanted to get close to comets to study them and especially to see how different individual comets might be among themselves."

"Bob Farquhar, whose expertise is celestial mechanics, had figured out an effective way of not just going to one comet but going to multiple comets, essentially as many as the budget would allow. This can be done by using a very clever technique of launching a spacecraft into an orbit similar to the Earth's orbit, so the spacecraft comes back periodically close to the Earth. This way we can use the Earth to deflect the spacecraft to the next comet you want to go to. It was a combination of my interest in finding out more about comets and Bob having a clever scheme of making it feasible. Farquhar deserves a lot of the credit for making the mission a possibility."

CONTOUR was selected as a Discovery mission the second time it was proposed. The first time it was a much heavier spacecraft, a significantly more expensive mission. Veverka recalls, "This was the first time the Discovery missions were being competitively selected, and the Lunar Prospector, a very inexpensive mission, was chosen. We thought there was a message in that, so the next time around we scaled down the size of the spacecraft and cost of the mission. When CONTOUR was accepted as a Discovery mission, it was a scaled down version of the original concept. It essentially will do the same thing, which is to study the diversity of comets and to be in the position to intercept a so-called new comet if one appears while the spacecraft is in orbit."

The Mission Comes Together

How did CONTOUR go from a concept to reality? Veverka says, "First you identify some science goals, things that you as a scientist lust to find out about, in this case, comets. What I really wanted to

find out more about, in terms of chemistry and mineralogy, is what actually makes up a comet nucleus. What are the complicated organic molecules that supposedly formed in the early solar system. They are still preserved in comets and may have contributed to the origin of life on Earth, when comets impacted the Earth."

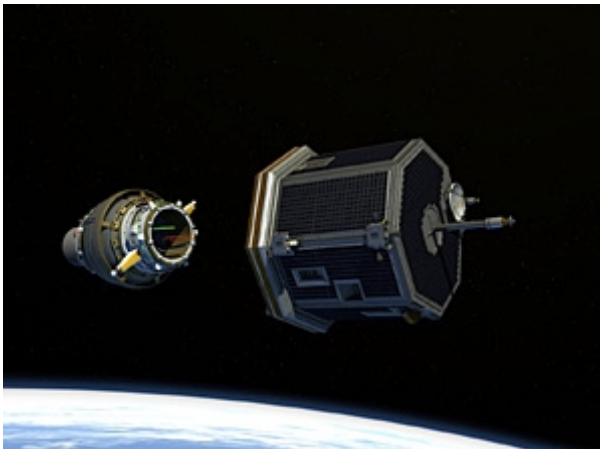


Artist's concept of CONTOUR encountering a comet.

Veverka's interest in composition determined the need for a mass spectrometer to measure the chemistry in great detail and something to analyze the dust particles. Veverka says, "I was aware that there were just a few people in the world that had built first class instruments. In the case of the chemistry mass spectrometers, I knew a group at Goddard who I had worked with before on other spacecraft, so I spoke to them about contributing a mass spectrometer to CONTOUR. For analyzing dust, there was only one group that had actually built these kinds of dust analyzers, and that's the group in Germany. These were people I knew from previous experience, so that was an easy choice."

Veverka was also interested in very high resolution imaging to find out how an object like a comet actually behaves when it gets closer to the Sun. He says, "The surface heats up, the ices evaporate, dust comes flying out—what actually is going on there in a geological sense? For that you need very high resolution imaging, and that's an area that I have worked on for 30 years or so, beginning with Mariner 9 which went into orbit around Mars. I contacted a number of colleagues who I had worked with before, who I knew were experts in very fast imaging, and made sure those people were part of the team. We also tried to include well known comet experts, people like Toby Owen, Paul Feldman, Anita Cochran. So you decide what it is that you want to do and who are the best people to help you do it."

An important consideration on Discovery missions is cost. Veverka says, "You always have to be aware of the fact on a Discovery mission you have well defined resources, so you have to get people who are able to build the best instruments for the most cost effective means. You also want to find a group of people that you can work with. We are all individuals, and there are some people who do not like working with us. Others find it easier to put up with us, so you try to find a compatible group. Finally, we need to consider that some of these missions, even Discovery, take years to complete, so you want to get a mix of more mature people and younger people who can help the mission achieve its final objectives and are still vigorous enough to do all the work that is needed."



Artist's concept of the CONTOUR spacecraft.

The Schedule Leading to Launch

The CONTOUR spacecraft arrived at the Kennedy Space Center (KSC) on April 24 and was transported to the Spacecraft Assembly and Encapsulation Facility-2 (SAEF-2) to begin final preparations for launch.

On April 29, the CONTOUR integration and test team will begin a system performance test to verify that all spacecraft systems are functioning to their design capabilities. The week of May 6, using facilities located at KSC's MILA tracking station, the Deep Space Network (DSN) compatibility test will be performed to verify CONTOUR's ability to communicate with the worldwide system of deep space tracking stations operated by the Jet Propulsion Laboratory.

On May 13, a five-day mission simulation will begin, again using ground station facilities at MILA to connect the spacecraft at KSC with the CONTOUR mission operations control center at the Applied Physics Laboratory in Laurel, MD. The mission operations team will follow a compressed timeline simulating the flight of CONTOUR, remotely commanding all of the spacecraft's systems and instruments.

On May 20, mechanical prelaunch preparations will begin, followed by installation of the spacecraft's solid rocket motor, attachment of the eight solar panels, and performance of a solar array lighting test. The spacecraft will then be placed on a spin-table for spin balance measurements. CONTOUR can then be loaded with its hydrazine fuel. A weight and center of gravity determination will be done and a final spin balance test will be performed. Finally, the CONTOUR spacecraft will be mated with a solid propellant upper stage that serves as the third stage of the Delta booster.

The Boeing Delta II launch vehicle is at Cape Canaveral undergoing pre-erection check out. Buildup of the launch vehicle on Pad A at Space Launch Complex 17 is scheduled to begin on May 28. CONTOUR will be transported to the pad and erected atop the Delta II on June 19. After a spacecraft functional test, there will be the integrated vehicle/spacecraft flight program verification simulated flight. Upon successful completion, the spacecraft will be closed out for launch and the vehicle nose fairing installed around the spacecraft.

CONTOUR is scheduled for launch on July 1, 2002 during a 12-second launch window at 2:56 a.m. EDT.

CONTOUR Education and Public Outreach Highlights

CONTOUR's E/PO team has defined three science themes that will be reflected in the activities and products they produce:

Comet Diversity

Comets are a mystery. Scientists aren't sure what their rocky, icy interiors or the dusty comas that surround them are composed of. How are comets uniform or different? Did comets form in different regions of the planetary nebula? Are comets' various origins reflected in their different compositions? Current models suggest two types of comets, and CONTOUR hopes to visit both. By measuring the locations of different rock/ice types on the nucleus and taking high-resolution images, scientists will determine the composition of the nucleus surface and processes that shape that surface. Researchers also will determine what chemicals make up a comet's coma.

Our Origins

Comets are thought to be primordial remnants of the planetary nebula from which Earth and the other planets formed. Unlike the planets, which have been overwhelmingly altered since their formation, comets are "primitive" objects in our solar system that have evolved little since their origins. Comets preserve a record of the chemical and physical processes at work during solar system formation.

Earth-Altering Contributions

Comets may have brought water, atmospheric gases, and even life-generating molecules to Earth. Only by visiting a variety of comets and measuring the abundance and isotope ratios for many neutral and ion species in the coma of each comet during the flyby can we contribute to the understanding of the chemistry of volatile elements that got incorporated into planets' atmospheres and oceans.

CONTOUR Comet Challenge

The CONTOUR Comet Challenge offers teacher and student teams the opportunity to participate in CONTOUR launch activities at Cape Canaveral, FL, in July of 2002, by developing a plan to share their excitement and experiences with their community.

This program is a unique opportunity for student and teacher teams to work with and learn from CONTOUR scientists and engineers and to experience the thrill of witnessing a rocket launch. During the days prior to the launch, the teams will have one-on-one interactions with the CONTOUR scientists, take part in a variety of educational events on the study of comets and the CONTOUR mission, tour the Kennedy Space Center, and attend a VIP briefing with the CONTOUR engineers and scientists. These activities will culminate with the excitement of viewing the spacecraft launch. Participants will then follow through with their plan to share their experience with

other students and community members.

Entries from 22 states were received. At the end of May, the selection of two middle school teams and two high school teams will be announced.



Laura Lautz, CONTOUR EPO Lead, working with elementary school students at the Dryden Chemistry Fair in Dryden, New York.

Educator Events

CONTOUR will host a workshop for high school physics and Earth science teachers this summer. The mission will also participate in the NASA [Solar System Educator Program](#), which includes 66 master teachers around the country who receive training about space science missions and learn curriculum-based, mission-related classroom activities, then go back to their community and train a minimum of 100 other teachers. There will be a CONTOUR/Solar System Educator workshop in Florida at the time of the launch, and CONTOUR will participate in the training institute for newly selected educators at JPL in Pasadena, CA, in August.

Public Events

Mission scientist Anita Cochran has hosted several public talks at the University of Texas and elsewhere in her region. CONTOUR brought former NASA astronaut Tom Jones to speak at Cornell in March and hosted Dr. Carolyn Shoemaker, the world's most successful living "comet hunter," at Cornell in April. The subject of her talk, aimed at science educators, was asteroid and comet collisions within the solar system. Shoemaker has discovered more than 300 asteroids and 32 comets, and is probably best known for her 1993 co-discovery of the Shoemaker-Levy 9 comet, which collided with Jupiter in 1994.

The NASA/JPL [Solar System Ambassadors](#), 278 volunteers across the country who conduct public events about space exploration in their communities, will receive a training on CONTOUR this spring and then host events nationwide that feature the mission.



Laura Lautz, lower left, CONTOUR EPO Coordinator, at the National Chemistry Week Chemistry Fair held in the Pyramid Mall, Ithaca, New York.

Ambassador Robert Gass will continue his tradition of hosting a launch day public event at Jetty Park, outside Cape Canaveral, affording excellent views of the launch and telling those who attend the pre-dawn event all about the mission and its goals.

CONTOUR Principal Investigator Joseph Veverka

Joe Veverka is a professor at Cornell University in Ithaca, NY, where he chairs the Department of Astronomy. Over the years Joe has been involved in many imaging investigations on NASA solar system missions including Mariner 9, Viking, Voyager, Galileo, Mars Observer, Mars Global Surveyor, Cassini and NEAR.

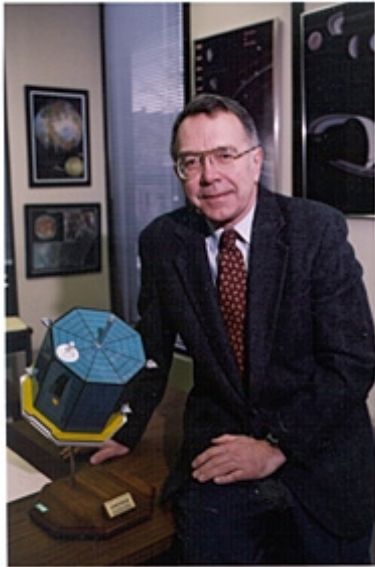
He played a leading role in the study of Phobos and Deimos, the two satellites of Mars, on the Mariner 9 and Viking missions, and coordinated the efforts of the Galileo Imaging Team during the first-ever spacecraft encounter with an asteroid (951 Gaspra, 1991). Joe was the leader of the NEAR Imaging/Spectral team, the first mission to perform detailed studies on an asteroid.

On CONTOUR, Joe is leading the team as Principal Investigator, or PI, the one person responsible for mission success. What are his thoughts on his role? "This is the first time I've been the PI of a mission," he says, "because it's kind of a different concept that NASA started with the Discovery Program. It's been a great experience. It's a wonderful way to do things, mostly because you do work with a small group of people who are dedicated to a well-focused, well-designed objective. Amazing things happen when you are given that opportunity to do something really exciting and have excellent people to help you. It's been a great experience for me. Now we all have our fingers and toes crossed that we will have a successful launch and a successful mission."

The CONTOUR Comets

How were the CONTOUR comets selected? Joe says, "It was a combination of factors. As a scientist, you know a little bit about some comets from Earth observations. In our case, comet Encke is a prime target because Encke is the comet that has the smallest orbit around the Sun right now, so it's the most baked out, or evolved, comet that we

know of. It's also hard to get to because its orbit is fairly eccentric and it comes close to the Sun, so it's a challenging, very interesting target."



**CONTOUR Principal Investigator
Joseph Veverka**

He continued, "We know that comets are diverse and that they evolve. When a comet comes close to the Sun, the ice melts and a lot of the volatiles get lost. The less volatile rocky material is left behind. There are comets which are fairly uncooked and comets that have been quite modified by solar heating. We wanted to get examples of both types. That's where Schwassmann-Wachmann 3 (SW3) comes in. It's probably much more volatile rich than Encke. Also you have to be able to get to these comets in a reasonable amount of time with the spacecraft that you have, so you have to consider what's available and what can you get to. Bob Farquhar developed a very clever mission design that has the flexibility to reach many targets."

Getting Data Back

After CONTOUR is launched in July, it will spend about six weeks in Earth orbit. In late August CONTOUR will leave the Earth and go into orbit around the Sun. Joe says, "In August of 2003, about one year later, we fly by the Earth again. At that point we will turn on the instruments to get images of the Earth. In a sense that will be our first real data. Very shortly afterwards, in November, we will encounter Encke, our first target. CONTOUR is a mission with intense periods of activity that don't last very long and, in between, we put the spacecraft in hibernation. In November 2003, for a few weeks before the actual encounter, we will start taking distant observations of star fields and comets to navigate in close to the target. The flyby itself is very, very brief. It's about a day of very intense data collecting, but actually most of it takes place

within about 30 minutes of the closest approach to Encke. We are hoping to fly 100-200 miles (160-320 km) from the nucleus and gather information on the composition of the gas and dust in great detail. We hope to be able to answer questions like — Is the water ice in comets of the type that could have been responsible for water we see on the Earth today? Are the kinds of inorganic molecules in this comet the kind that could have led to the origin of life on the Earth? We will be taking extremely high resolution images."

Joe continued, "Last year Deep Space 1 got some really beautiful pictures of comet Borelly, but if our experiment works, our resolution will be 10 or 20 times better than that. It's going to be a tremendous step forward. That's only 15 months from now, so we'll have a lot of exciting data real fast. We're trying to make a very effective pipeline so that the data can be processed very quickly into a form that is not only interesting but understandable to the general public. The plan is to play back the data within a few days of the encounter, and we will try to release the images and all the interesting data immediately. It should be exciting, and we're raring to go."

A big part of the reason that the data will be available so fast is thanks to the NEAR mission, where Joe and others had experience with software to reduce a lot of data fairly quickly. "We're going to take advantage of that", Joe says, "We're benefiting from our experience on a previous Discovery mission to make this one a little bit more efficient."

Once the data are available, scientists will spend years doing further analysis to assess what it all means. "There are some results you can get from the data almost immediately," Joe notes, "while other things require years of scratching your head and understanding slow but very important details." Won't the answers produce even more questions? "Exactly," says Joe, "that's the thing that sounds frustrating. You go into a mission with a few questions and you end up with many more questions afterwards. But if you think about it, that's really how all of life is. In life you worry about something and it gets resolved, but that leads to many other things. That's the way we humans interact with our environment and the universe. We learn a few things, and that leads us to be able to ask more questions. I think that's fine, and I don't think that will be any different with CONTOUR."

CONTOUR is a very challenging mission because the spacecraft has to fly at very high velocity, coming very close to comets with tails spewing out dust. About these potential obstacles, Joe says, "As far as I'm concerned, and probably everyone on CONTOUR, about five minutes after closest approach at Encke will be when we will really feel that this mission has done its thing. Until then, anything can happen, so we still have a year and three months of fingernail biting. Lots of things have to happen between now and then, but that's the crucial one. We have to get through that encounter and get the data back to Earth. I think with that experience behind us, the second encounter will be much easier to live through."

The Future

While Joe says he would like to be the PI on a Discovery mission again, he feels he probably will not propose one again, to give others a chance to do "all these neat things." Are there any missions he would like to see his students propose in the future? "Yes," Joe admits, "there is a mission very close to my heart that I would like to see someone do. It's a Discovery mission, and it has to do with my favorite asteroid, Eros. As you know there is a spacecraft right now on the surface of Eros. From all the things that we

learned about Eros and all the questions that have been raised by NEAR, I think it would be very important for a spacecraft to go back to Eros, actually land on the surface and return geological samples of Eros for detailed analysis on the Earth so we can answer some of the remaining questions. And bring back a piece of the NEAR spacecraft. I think that would be a wonderful thing to do."

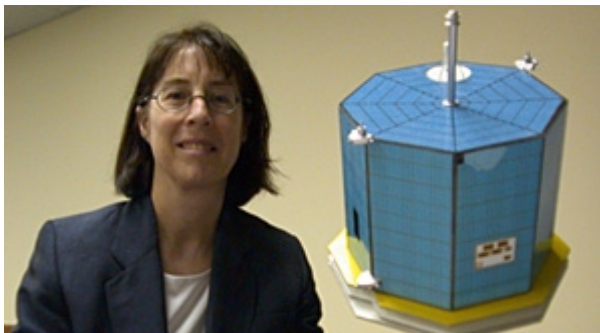
On the personal side, Joe has two sons, one in graduate school in aerospace engineering and the other an undergrad math major, both at Cornell. When not working, Joe likes to be somewhere in the wilderness, fishing, hunting and enjoying the great outdoors.

Words of Advice

Joe's advice for new PIs is that even a Discovery mission is something you can't do by yourself, so you really need the best people possible to help you. "First of all," he says, "think of some really good, scientifically valid idea, and then get the best possible people to help you. Just keep at it and eventually success will come your way."

CONTOUR Project Manager Mary Chiu

Mary Chiu is a physicist by training, but her work at the Applied Physics Lab (APL) has mainly been in program management, ranging from space flight components to entire spacecraft. She was the program manager for NASA's Advanced Composition Explorer (ACE) spacecraft that launched in 1997 and for many spacecraft that APL built for the Navy. Mary has been the CONTOUR project manager since the mission was selected as Discovery #6 in 1997, and after launch she is planning to retire, relax, and travel.



CONTOUR Project Manager Mary Chiu

Mary received her B.S. in Physics from the University of Toledo and her M.S. in Applied Physics from The Johns Hopkins University Evening College. She began her career at APL right out of college, working on a wide variety of projects, including modeling and analyzing electromagnetic field effects and operating APL's Time and Frequency Laboratory. Moving into program management for APL's Space Department, she took on responsibility for all of the technical, quality, cost and schedule aspects of the programs she led.

Mary got involved with CONTOUR prior to the release of the announcement of opportunity in 1996. Principal investigator Joe Veverka had worked with Ed Reynolds and Bob Farquhar at APL in the previous Discovery submittal. When they were preparing to submit their proposal to NASA for the second time, the management at APL's Space Department asked Mary to meet with Joe, Ed and Bob, and she was then chosen to manage the project. CONTOUR's selection was announced in October of 1997, and work began in February of 1999.

Mary's role in recent months as launch approaches has mainly been monitoring the testing and making sure everything is being coordinated to get the testing done. She's responsible for assuring that mission operations preparations and launch site preparations get done. After the spacecraft moves to the Kennedy Space Center, Mary will stay at APL to continue monitoring the activities there, while other team members will travel to Florida to participate in the final preparation activities.

CONTOUR Faces Two "Launches"

One unique aspect of the CONTOUR mission is that there are, in a sense, two launches. According to Mary, "After launch from Cape Canaveral we go into approximately a six week phasing orbit which will position the spacecraft for the second "launch" using a solid rocket motor integrated within the spacecraft. After the solid rocket motor firing, a check-out of the imager is scheduled. Following that, the spacecraft will be placed in its first "hibernation" which will last until June or July 2003, just prior to the Earth flyby in August. The encounter with comet Encke will then take place in November.

CONTOUR will cruise between comet encounters and Earth swingbys in a spin-stabilized "hibernation" mode, designed to help the mission reduce spacecraft operations and Deep Space Network tracking costs. CONTOUR will hibernate for 65 percent of its journey - the first deep space mission to spend more time hibernating than actively operating.

During five separate cruise periods - ranging from 120 days to 300 days long - mission operators will turn off CONTOUR's instruments and most subsystems; only the command receivers, thermostatically controlled heaters and critical core components stay on. The command systems automatically monitor spacecraft status and correct potential faults.

Ground controllers wake the spacecraft by sending "active spin mode" commands 35 days before each Earth swingby. This gives them enough time to track the spacecraft, check the instruments and prepare for the swingby maneuver.

This pattern of Earth swing-by will be repeated prior to the encounter with Schwassmann-Wachmann 3, and can be used to make adjustments or if there are opportunities to target a "new" comet.

Partnering and Good Communications

Discovery missions involve a lot of partnering. What has this experience been like on CONTOUR from the project manager's perspective? "I think it's been very positive," Mary says, "We have a relatively small team on CONTOUR. It's primarily Cornell, APL, Goddard and JPL. We certainly have a lot of vendors that we consider partners, and have a good working relationship with. The JPL navigation guys are the best. The Deep Space Network guys have been really fantastic in their support. The Goddard instrument people on the NGIMS have been very supportive all through testing. Joe, of course, is great to work with. The Germans who built the dust analyzer were great because they delivered on time and they haven't had many problems at all. They got to the Baltimore airport on Sept. 10th, late at night. We got the instrument inside APL later that night, and then the next day the Lab was closed and no one was allowed in. Thank goodness they came in on the 10th, or we might not have a dust analyzer."

How did she assure good communication with the different people, personalities, and institutions working together? "I think email has really enhanced communications so greatly," Mary says, "We did certainly have a fair amount of telecons but with email you can go back and forth quickly with a lot of information. I think many of the team members have known one another from other experiences, and that certainly has helped also. It's been a very good, well coordinated effort, and actually it's been a fun team to work with."

The Challenge of ITAR Laws (International Traffic in Arms Regulations)

CONTOUR had a rather diverse vendor base, with several major vendors in Europe. According to Mary, "We were procuring off-the-shelf products but the new requirements for interfacing with foreign nationals, even for mundane things, call for increased scrutiny, paper work and everything else. It was a bit of an impedance, and it kind of caught us off-guard. We've definitely learned a lot. MESSENGER certainly will benefit from some of the things we had to go through on CONTOUR. As many of the NASA missions become more international, there's been another layer of bureaucracy and impediments added for doing international coordination."

Mary continued, "There were lessons learned. We now know that we have to get export licenses for anything that we are procuring, just in case we have to send something back. It turns out that once foreign material hits U.S. soil, even if it's just temporarily on a U.S. loading dock, it becomes subject to U.S. export laws. That certainly was not something that anyone here had been all that savvy about. We now know. It was a tough lesson to learn. We

got caught up in it. Fortunately things turned out very well. Our foreign vendors have been very, very cooperative and have worked with us. They were all on time or early with their deliveries, which allowed us to take this hit with the problem we had with U.S. Customs. It certainly was an eye opener."

The Satisfaction of Seeing it all Come Together

Discovery missions have finite resources. Budgets and schedules are tight, and going from words on a proposal to actual hardware and software is a giant leap. Mary says, "For me, being on this project from the very start, I think the most pleasurable thing has been seeing it go from a kernel of an idea, the concept, all the way through to become reality. It's very satisfying to see a lot of the development and how people came through at just the right time with an idea to make something work and all of the contributions from various people working together. Now to see it going through tests, performing beautifully through those tests, has been very rewarding. Not everyone gets that view."

With very aggressive schedules, it takes a lot of focus to stay on track. Mary says, "You have to make decisions in a timely manner to keep work progressing with this type of schedule. I've seen people working on other programs where the launch date keeps getting delayed further and further and that can get frustrating. I think there's got to be a happy medium between these real fast schedules, like NEAR and CONTOUR, and a Galileo-type mission. The Discovery concept of Faster/Better/Cheaper I think is still my preferred method. Just not quite as fast. When you only have a fixed period of time, the added reviews make it more difficult."

The Best Man for the Job is.... a Woman

As the first woman to manage a Discovery mission, Mary has proven that gender is not a barrier to technical excellence. Has she faced any difficulties as a woman in a leading technical role? "When I first started out it was a little bit different," she says, "but now I think there is a fairly good mix. So no, I would not say that I've had any problems or issues. I think they pretty much treat me like one of the guys."

CONTOUR Mission System Engineer Ed Reynolds

Ed Reynolds earned his B.S. in Electrical Engineering from Virginia Tech in 1985, and has been at APL ever since. In his role as integration and test engineer for nine years in APL's Space Department, he worked on a number of NASA and military spacecraft. As system engineer his most recent projects have been BMDO's APEX North Star Mission, NEAR, and CONTOUR.

As the launch of CONTOUR draws closer, Ed's recent efforts have been concentrated in two areas. He is coordinating with the launch site, handling issues of the day-to-day processing that need to be dealt with. He oversees the procedures to be used and any safety issues that come up. The other facet involves the activities of the ongoing testing.

"There has been a lot of prioritizing of any issues that come up," he says, "Things like who gets spacecraft time and just making sure that open issues do get closed out." He will follow the spacecraft to the Kennedy Space Center and be the main interface for the mission there. After launch, Ed and other

lead engineers who designed and built the spacecraft will be on-call to provide any insight, support or analysis that's needed by the mission operations team.



CONTOUR Mission System Engineer Ed Reynolds

What has been the most satisfying part of the mission for him? Ed says, "People think because CONTOUR is low cost, they get this view in their head it's a very tiny spacecraft. When you walk them in to view it for the first time, they see it really is quite large. We took a lot of hits for using plain aluminum, and we were using a lot of existing designs. People initially thought that CONTOUR was very inefficient mass-wise, but it turns out to be the most efficient spacecraft structure that APL has ever built, and that includes when we've used exotic components. So when people have such low expectations and it turns out to be a very large spacecraft that is extremely efficient in the way it was built, that's very satisfying."

Does he have any aspirations to work on another Discovery mission? "Yes, I do," Ed says. "You do need breathers though. You are going up against 30 other very good, well-thought out proposals. You put so much of yourself into the proposal and then once you've won it, you have 3-1/2 intensive years where you are working to very strict launch dates, given the nature of Discovery. When you're the guy who has to make the hard decisions to keep the program on track, you have to carefully assess the tradeoffs. The need to perform all the time is always there. I'm looking forward to taking a little bit of a breather before I jump back into the fire."

As this newsletter goes on-line, Ed has been named Deputy Project Manager and will assume the role of CONTOUR Project Manager after launch.

Genesis Still Catching the Wind

The [Genesis](#) spacecraft continues solar particle collection. The team has begun work on the next spacecraft background sequences containing flight software diagnostics, data management, clock correlation commands, daily precessions, ion and electron monitor calibrations, and collector array management. On May 22, Genesis will conduct its fourth station-keeping

maneuver, which ensures that the spacecraft maintains its orbit around the Lagrange point.

[The Los Alamos National Laboratory \(LANL\) Genesis mission data](#) web site is now open to the science community. The site contains solar-wind browse plots based on on-board calculated ion moments and electron spin angle plots from August 24, 2001 to present. Browse plots are generally posted within 1-3 days, allowing views of very recent solar-wind activity. Within the next two months, the LANL Science Data Collection Team will begin adding ground-processed data files.

On January 31, Genesis Deputy Project Manager Lloyd Oldham retired from Lockheed Martin Astronautics. Lloyd's dedication to managing the design, manufacture, assembly, and test of the Genesis flight system resulted in a model cooperative team effort. When asked about his career at Lockheed, Lloyd said, "My background in applied science, communications, and engineering have given me a unique ability to manage multidisciplines. Having an understanding of virtually all of the engineering disciplines has enabled me to work in 11 totally different technical fields. What a surprise it has been!" Best wishes to Lloyd, as he directs his energies toward his many other interests.



The LANL Science Data Collection Team.

Education and Public Outreach Highlights

On February 21, the Genesis mission sponsored a kid-friendly webcast titled "[Kids Get Down With Gravity](#)" in conjunction with National Engineers Week. JPL Trajectory Analyst Jennie Johannesen and Genesis Mission Project Manager Chet Sasaki joined Alta Loma, CA, teacher Tom Curley and students in an activity that examined how gravity affects skateboards AND planetary orbits! Classroom teachers can access the accompanying [mathematics activity](#).

March is education conference month in the world of mission education and public outreach. Genesis mission representatives were at several national conferences, including the Association for Supervision and Curriculum Development (ASCD) conference March 9-11 in San Antonio, TX, and the National Science Teacher Association (NSTA) conference March 27-30 in San Diego, CA. Conference attendees were excited about online Genesis interactive technologies and instructional resources ready for classroom use.

Deep Impact Approved for Implementation

The [Deep Impact](#) mission passed a major milestone toward its January 2004 launch and July 2005 encounter with a speeding comet when it successfully completed a three-day critical design review in early February at Ball Aerospace in Broomfield, CO.

After examining details of the mission, three independent review boards concluded that the design is mature and ready to proceed to building and testing the project's two spacecraft, the flyby and the impactor.

Principal investigator Mike A'Hearn said, "This was a major step for us in ensuring both ourselves and NASA that our designs are solid and reliable." For all missions, the critical design review is the point at which the detailed design is approved and the project is authorized to complete the building of all the hardware and to prepare it for launch.

For this mission, the CDR had three separate review boards. The Deep Impact project has its own standing review board of personnel from outside the project, who follow the project closely. JPL's Systems Management Office appointed a review board to ensure that JPL management is aware of all aspects of the mission. NASA appointed an Independent Assessment Team to provide an independent assessment of mission readiness at this stage of development. All three review boards found that the Deep Impact system design was mature and the project was fully ready to start the spacecraft and science instrument fabrication, assembly, integration and test phases.

The next major review of the system will be in February 2003, when the integration and test readiness review is conducted prior to buildup of the spacecraft and environmental testing.

Education and Public Outreach Highlights

Outreach team member Maura Rountree-Brown and Art Hammon from JPL's Education Office have developed and given a series of workshops on "Why We Explore Comets" to the staff members at the NASA Educational Resource



Students enjoying their ice cream comets.

Centers. The activity covers the basics of comet science with background information and activities that will soon be a formal educational unit for grades 1 – 12.

Deep Impact did two workshops with L.A.'s BEST, an after school program for Los Angeles inner city youth. Their activity was a lesson on comets.

Partnering with Richard Shope from JPL, outreach team member Maura Rountree-Brown is collaborating with elders from the Lakota tribe in South Dakota to develop an activity that combines space science with Lakota history of culture and astronomy.

The Deep Impact web site was a "Cool Site" in the Netscape Open Directory Cool Site Award.

Reviews Boards Give MESSENGER Thumbs Up

[MESSENGER](#), the first mission to orbit the planet Mercury, took a big step toward its scheduled March 2004 launch when it passed a thorough four-day critical design review at the end of March. A project advisory panel and NASA assessment team examined every detail of the mission and spacecraft design and gave approval to start building the spacecraft and scientific instruments.

"The review was very successful," says project manager Max R. Peterson, "Both panels confirmed that our designs are sound and meet the mission's science and engineering requirements. We're ready to move to the next stage."

MESSENGER team members are building flight hardware now and will begin integrating parts on the spacecraft this November. After launch and a five-year journey through the inner solar system, MESSENGER will orbit Mercury for one Earth year, providing the first images of the entire planet and collecting information on the composition and structure of Mercury's crust, its geologic history, the nature of its thin atmosphere and active magnetosphere, and the makeup of its core and polar materials.

"The project is well on its way," says Dr. Sean C. Solomon, MESSENGER principal investigator. "Exploring the many mysteries of Mercury will help us to understand all of the terrestrial planets, including Earth. The team is eagerly looking forward to assembling and launching the spacecraft and to the first new data from the innermost planet."

Education and Public Outreach Highlights

The Challenger Center's Window on the Universe program in Nogales, AZ, took place Feb. 24-29, 2001. A team of researchers, educators, and engineers, including Dr. Mario Acuna (MESSENGER Magnetometer, NASA GSFC), spoke to 6,000 K-12 students in classrooms and conducted two Family Science Nights, reaching 2,000 parents, students, and teachers. The Window on the Universe program is designed to increase scientific awareness in selected communities, with the intent to empower them to develop lasting collaborations between area schools, museums, science centers, businesses, families, and other local resources.

Work to revise the MESSENGER web site continues, with new animations being produced. Also, the MESSENGER film documentary crew has conducted interviews, documented the process of shock testing the solar panels, chronicled pre-CDR activities, and covered the recent science team meeting and the CDR.

Stardust Continues Toward 2004 Rendezvous

The [Stardust](#) spacecraft continues on its journey to Comet Wild 2, with regular tracking passes by the Deep Space Network showing all subsystems are normal. Stardust is currently 2.71 AU (252 million miles or 405 million kilometers) from the Sun.

The spacecraft's power subsystems continue to perform better than predicted. However, to ensure a positive power margin, the spacecraft will not be contacted from April 11 to April 25, when the spacecraft passes its farthest from the Sun. Stardust will reach aphelion (its farthest distance from the Sun) on April 18 at a distance of 2.72 AU.

After 33 years at JPL, Dr. Kenneth L. Atkins has retired. Ken was the Stardust Project Manager during its development, launch, and initial operations phases. The team gathered to celebrate with Ken and wish him well. He leaves behind a rich heritage, including the excellently operating Stardust spacecraft.

Education and Public Outreach Highlights

In March, Principal Investigator Don Brownlee participated in a web chat with members of the [JPL Ambassadors Program](#). The Ambassadors are volunteers who organize and conduct public events in their communities to share the excitement of NASA's missions, discoveries and plans for Solar System exploration.



From left to right: Joe Vellinga, Stardust Program Manager (LMA), Ken Atkins, former STARDUST Project Manager (JPL), Tom Duxbury, STARDUST Project Manager (JPL), Don Brownlee, Stardust Principal Investigator (University of Washington).

The Stardust Outreach team supported the National Science Teachers Association Conference in San Diego, CA, where about 7,000 people attended. Outreach led 8 workshops within the conference centered on the exploration of planetary bodies, including asteroids and comets.

Other outreach activities in the past quarter included support of Space Week and Space Camp at the Western Colorado Math and Science Center; presentations at the U.S. Space Foundation in Colorado Springs, CO; the Houston Museum of Natural Sciences, and the Young Astronauts Club in Springfield, MO; and talks to students at California State University and Talbot Elementary School, Gainesville, FL.

Discovery Dispatch

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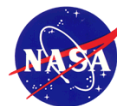
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